



The Summer Circuit

This July has been the most promising month for the summer low band enthusiast in a number of years. DX operations from Aves (YVØRCV), Congo (TNØCW), Ghana (9G1MR), Central Kiribati (T31BB), Kerguelen (FT5XJ), and Chad (TT8/F5LGF) were active, just to name a few of the exotic calls to appear on the low bands.

Pacific activity has picked up significantly with A35XC, P29VH, V73C, FK8FU, AHØT, FO5OK being spotted on a number of mornings during this normally slow month.

Toss in FR5DN, C53HG, PYØFF, FR5DN, 9K2ZZ, and you wonder what might be in store for us later this year.

Hard Core Summer DXer's

David, N2KK never stops his assault on the 80 meter band. During the month of July he has worked 44 countries and 28 zones on the 80 meter band. He worked FT5XJ on four different occasions, just to let him know that his signal was being heard.

The FT5XJ operation brought joy to Fred, K6SSS, who connected for DXCC Country #282 all time on 80 meters with this one, during a normally benign summer month.

Bill, WØZV, was the first subscriber to report the TNØCW operation on 160 meters. Rudi, DK7PE's Congo effort also gave Bill a new one on "Top Band". Can you imagine the odds of working country #255 on 160 meters during the month July! Congratulations Bill.

The YVØRCV group was a nice surprise on 160 meters. Merv, K9FD says "strong signals" around 0245Z on July 23. Al, W8AH worked him at 0103Z on July 21. Jerry, WB9Z easily worked them at 0410Z on July 15 and Gary, NI6T found them at 0602Z on July 20.

Your editor has missed most of the excitement this month trying to restore an old car, paint the sunbleached fascia of the bungalow and master his new pitching wedge. He complements those who maintain their DX discipline during the summer.

Low Band Survey

The recent surveys that appeared in our June issue of the *Low Band Monitor* are coming in nicely and I would like to remind you to send yours in as soon as possible. This data is very important to the success of this newsletter and should only take a few minutes for you to complete.

Some of you have noted on some of the DXpeditions that you didn't work the operation because you had worked them before. This is fine, but we are only interested in your contacts for the period in question.

Please take the time to send in your surveys. We have established August 15 as a deadline. You will be glad you did!

The ZD9SXW 160 Meter Log

Roger, G3SXW, had a small problem with a corrupted file, but was kind enough to hand copy the ZD9SXW 160 meter log for our readers. Since Roger has a very legible handwriting, I decided to scan this copy rather than retype it, so that there would be no chance for error.

It is now in Encapsulated Post Script (EPS) file format that can be enlarged to billboard size. Believe me if I was in this log, I would at least have the image made into poster size!

For more information about this DXpedition, read the recent article by Roger, G3SXW in the July, 1994 issue of QST.

Elevated Radials

There is a two part article on elevated radials in this newsletter. Two articles from the *IEEE Transactions On Broadcasting* are reviewed for basic background information and then the editor replicates an elevated radial system on the 160 meter band and attempts to verify the information contained in the articles.

Elevated radials are not new, but developments in computer modeling now allow us to be confused about them in ways that were never thought possible a few years ago.

The latest "hot trick set up" for elevated radials is reported to be 16 elevated radials at 3/8 wavelength. Does this sound like a viable system to you? I think I will pass!

Look these articles over carefully. You might want to consider an approach like this for your low band vertical antenna(s) this season.

Next Low Band Season

We would like to remind everyone that our second low band "season" will begin on September 1, 1994 and end on April 1, 1995. This note is important because most of our readers will not receive the August issue until after this starting date.

We wish to recognize those people who are really active on the low bands during this period and will administer the program similar to our efforts of 1993-1994.

160 Meter Band - All subscribers who achieve a Worked All Continents on the 160 meter band will be recognized.

80 Meter Band - All subscribers who work 100 countries on the 80 meter band will be recognized.

40 Meter Band - All subscribers who work 150 countries on the 40 meter band will be recognized.

All participants will be recorded in order of the date their logs are received. Additional details will appear in a future issue of the *Low Band Monitor*.

The second "season" will be interesting for many reasons. We have already established some benchmarks from the first one that will define relative performance. We are a year closer to the bottom of our current sunspot cycle and should enjoy even better conditions than a year ago.

DXpeditions will be more prone to operate with zeal on the low bands simply because of the very limited opportunities on more traditional frequencies. Have you heard 15 meters lately?

This should be one of the best opportunities in the history of the hobby to be successful on the lower frequency bands.

We sincerely hope that you can join in on the fun this time.

If you are planning to improve your antenna system, be advised that you have less than thirty days left before the games begin.

Saving That Old Amplifier

With K4BWC and WA4DRU - by KØCS

HF Amplifiers can literally last forever if periodic maintenance is performed and a source of spare parts is available. A number of domestic HF amplifier companies have left the market leaving the owners of some of these models without aftermarket support. This article reviews two of the new "players" who have identified the need for parts and information for these potentially derelict amplifiers.

The Good Old Days - A few years ago, when I was working in a healthy Fortune 500 environment, an HF amplifier purchase wasn't trivial, but it was certainly a financial transaction that could be managed. Today I have no plans to buy a new Alpha 87, but believe I am having more fun keeping my old amp on the air.

I'm poor, but I'm politically correct now. Recycling is in!

My amplifier evolution, since 1971, started with a Drake L4-B, Dentron MLA-2500, Alpha 76CA, Alpha 77, Alpha 77S, Alpha 374, Kenwood TL-922, Heathkit SB-220 and an Amp Supply LK-500 NTB. That's nine amps in twenty-four years.

If you look closely at this list you can see a trend that initially climbs upward into the high price points and then declines into used, almost entry level type equipment. One's HF amplifier tends to define your economic status. Could a Clipperton L be next?

The less glamorous amplifiers can provide excellent service on the low bands for the cost conscious enthusiast, but they require a different ownership philosophy - call it "hands on".

Alpha amplifier ownership is, as most of you know, very sanitary. I cannot recall any service or serious maintenance on any of the Alpha amplifiers I have owned. You turn them on, work the DX and shut them off. My only encounter with Ray Heaton of Alpha was due to low output on the 10 meter band that was solved by shortening the coax between the transceiver and amp by a few inches. That's right, 500 more watts by tweaking a piece of coax.

A Watt Is A Watt - Older amplifiers provide more of a challenge to own and operate. Today I find myself thinking about mundane things like cooling fan revolutions, meter shunt resistors and filter capacitors.

My latest purchase, the Amp Supply LK-500 NTB, is a dual 3-500Z, 10-160 Meter design that has QSK and requires no tune-up. Purchased used for a song, this unit featured brand new finals, but had a bad grid current meter and two (out of six) fried plate capacitors. This unusual design had nine variable capacitors in all for the rather primitive, but interesting, no tune-up scheme.

My initial strategy was to nurse the amp through the winter and then perform a serious rehab this summer. A few parts, some TLC on the lead dress and a little paint and I would be in business.

After six telephone calls to various suppliers, including a very friendly and well meaning representative at Ameritron, who had no parts for this particular amplifier, I discovered that I was not going to find parts that easily.

Omega Electronics - As a last resort, I called Omega Electronics in North Carolina. I had seen their ads in the Yellow Sheets, but was simply not aware that Bill Edwards, K4BWC, the owner, was sitting on a motherload of OEM Amp Supply Parts.

I gave him my model number and to my surprise found out quickly that he knew my amplifier (Serial #906), because he had

assembled it! Bill was intimately involved with Amp Supply when they were still in business. Both variable capacitors were in stock and so was the grid meter. In four days I was able to install the parts and now have a fully functional LK-500 NTB for under \$700.00 including the new parts.

Omega Electronics parts are not cheap, but they are correct for the application, as they are the exact replacement parts used by the manufacturer. More importantly, Bill Edwards can offer valuable insight about the entire Amp Supply product line that is probably not available elsewhere.

I actually enjoyed the rehab process of cleaning the amp thoroughly, improving some of the lead dress and providing the cabinet with a nice new coat of paint. This amp is now in better condition than when it was new.

Omega also offers service support for those who are not inclined to do their own amplifier repairs.

Bill has a small parts catalog available and can probably assist you with a number of generic amplifier needs other than those made by Amp Supply. The Dennis Had, K8KXK designs of Dentron used a number of parts common to those of Amp Supply, so Dentron owners should also keep Omega Electronics in mind. Coupling capacitors, plate chokes, input coils, meters, reduction drives, bandswitches and more - Omega Electronics has all the parts you need to restore an Amp Supply product.

Contact: Omega Electronics, 101-D Railroad Street, Knightdale, NC 27545, (919) 266-7373, FAX (919) 250-0073.

Heathkit's Glory Days - I feel very old when I think about Heathkit. In the 1970's this company would routinely have eight commercial slots at the Dayton Hamvention™ and an entourage of Engineers and Product Managers, all dressed in three-piece suits at the show, promoting the extensive Heathkit product line.

A few years ago, a few Heathkit chaps quietly showed up at Dayton in jeans and sweatshirts to liquidate what was left of the once proud amateur radio product line. It was a pitiful sight. Times have sure changed, Heathkit is gone and so is the product support and parts availability they provided for decades.

The Heathkit SB-220 Amplifier - This amplifier pretty much defined the desktop kilowatt market for over a decade and there are thousands of these amplifiers still in use today.

More importantly, a number of sound design improvements exist that allow the owner the potential for extending the life of the product even further and also improving its performance.

I purchased a Heathkit SB-220 a few years ago for one reason; I wanted to convert it to Six Meter Operation, so that I could work Europe on Six Meters when an F2 opening existed. During this ownership period I discovered that some great upgrades are available that can easily be implemented by the owner. These upgrades have all been discussed in many of the amateur radio publications. Would you believe that the converted SB-220 put out a full kilowatt on Six Meters!

Harbach Electronics - A recent entry in the SB-220 upgrade field is Harbach Electronics of Melbourne, Florida. Allen Harbach, WA4DRU, is not new to amateur radio and is probably best known as one of the North Florida DX Association Contest operators that

enjoyed great success in the 1970's from Turks and Caicos.

At this time AI offers seven different upgrade kits that will allow the SB-220 owner to truly modernize the unit's design. AI's flyer says. "Resurrect that SB-220 - A replacement costs \$2000." If you have priced paired 3-500Z desktop amplifiers lately you know that AI is correct.

Here's AI's current offering: (All prices are for U.S.)

1. *PS-100 Parasitic Suppressor Kit* - Reduces the potential for arching caused by oscillations at VHF frequencies. A great investment at \$17.00.

2. *FM-100 Fan Blade and Motor Kit* - Reduces noise and improves cooling. Simple installation and only \$24.00.

3. *RM-100 Rectifier Metering Kit* - Replaces the rectifier and meter resistor unit. Superior components for \$29.00

4. *FB-100 Filter Capacitor Replacement Block* - This very vulnerable area can be replaced with superior parts in 20 minutes of bench time. Computer matched only \$115.00.

5. *SS-100 Soft Start Module* - Provides a gradual inrush current of around 6 amps (compare to 100 amps!). This is a true rig saver and it's only \$30.00.

6. *MM-100 & PM-100 Meter Replacements* - Almost exactly like the originals. Both the Plate Voltage and Plate Current Meters are available at \$35.00.

7. *BF-100 Bottom Feet Kit* - These are always needed. Only \$2.65 for good polyethylene replacements.

The addition of AI's kits and a little luck will add years to your Heathkit SB-220. These kits will also make you think twice when you see an ugly looking SB-220 at a swap meet for \$300-\$400.

For further information about these SB-220 items contact: Harbach Electronics, 2318 S. Country Club Road, Melbourne, FL 32901, (407) 723-7145.

SAFETY FIRST

Don't even think about working on an HF amplifier with the unit energized!

**Perform all work with the unit disconnected from the AC mains and your transceiver.
NO EXCEPTIONS!**

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THE EDITOR'S AMPS - The Rise and Fall...

1. **DRAKE L4-B** - This 10-80 meter unit was purchased while I was living in Dayton, Ohio. A fine piece of equipment that had the most conservative power supply ever used in an amplifier of this type. Today manufacturers run a lot more voltage on the 3-500Z pair than Drake did. If run properly, both this model and the later L-7 could last forever, but the output is at least 25 percent lower than today's standards and they were not desktop designs.

2. **DENTRON MLA-2500** - This 10-160 meter unit used the radially cooled Eimac 8875's instead of the axially cooled 8874 pair. Tremendous value for the money and a great DXpedition amplifier. A great desktop design, but not suitable for extreme duty applications like RTTY or 50 wpm CW. Dentron lead dress was also not a strong point.

3. **ALPHA 76CA** - Three tubes run cooler! This is the definitive "contest amplifier". Three Eimac 8874's run at legal power levels is a very nice set up. Simple removal of the transformer made this amp very portable. The Achilles Heel has always been potential tube replacement costs-ouch!

4. **ALPHA 77** - This early single 8877 design did not have the success of the later 77D model, but in general was a wonderful piece of equipment when compared to the earlier Alpha 70 vapor cooled models. Not a good amp for DXpeditions.

5. **ALPHA 77S** - This is the famous two tube Eimac 8877 model that would fit in well at WWV or any other 100 percent duty cycle application. A true "big boy toy" that everyone should own at least once in their lives. I let this one go to finance the purchase of a sports car.

6. **ALPHA 374** - This was one of the early no-tuneup models that introduced the user to convenience. Mine used only two 8874's but was a joy to operate at a kilowatt.

7. **KENWOOD TL-922A** - The best lead dress of any amplifier I have owned - absolutely flawless. The 10 meter modification is not for beginners and the Achilles Heel is that you cannot U.P.S. this unit. Definately overpriced, but so are Honda Accords.

8. **HEATHKIT SB-220** - Crude but the best value you can get for your money. A vast assortment of modifications improves the breed. No 160 meters. Can easily be modified for use on the 6 meter band if the 10 meter bandswitch position is sacrificed.

9. **AMP SUPPLY LK-500NTB** - An unusual hybrid dual 3-500Z no tune up design with nine variable capacitors and a huge power supply. Lead dress is marginal when compared to Alpha or Kenwood.

Elevated Radial Systems

IEEE Crib Notes from Christman, Radcliff, Zeineddin and Breakall - by KØCS

The Low Band enthusiast has always been looking for the best possible vertical radiator for the 80 and 160 meter bands. Recent articles in a number of technical journals have indicated that an elevated radial system can be utilized to improve vertical performance. Lets review the elevated radial concept and then use it in a real world application.

While visiting the U.S Department of Commerce, Mountain Administrative Support Center, in Boulder Colorado, I stopped at their technical library to look at a couple of articles on elevated radials that appeared in some recent *IEEE Transactions on Broadcasting* journals.

Reference to the first of these articles has been made a few times in QST. John Brosnahan, WØUN, who is a subscriber to *IEEE Transactions on Broadcasting* told me about second article.

The MASC has a very impressive library, one that contains technical journals from all over the world for all of the physical sciences that impact amateur radio.

The two articles in question were, Using Elevated Radials with Ground Mounted Towers, in Volume 37, No. 3, September 1991, by Christman-Radcliff and Using Elevated Radials in Conjunction with Deteriorated Buried-Radial Ground Systems, in Volume 39, No. 2, June 1993, by Christman-Zeineddin-Radcliff-Breakall.

These are two of the articles that have helped perpetuate the trend towards the use of elevated radials in low band vertical antennas by amateur radio enthusiasts. The authors are writing these articles for professionals in the broadcast field and use the middle of the AM broadcast band as a reference frequency. Their results are definitely applicable to the 160 meter band. The authors used a double precision version of methods-of-moments code NEC-GS, that was developed by the Naval Ocean Systems Center in San Diego, California, to develop their findings.

The Public Services Librarian, Jane Watterson, had the two journals in my hand in a matter of seconds and advised me that I would not be able to photocopy them because I was not part of the Colorado University research community, nor a paid member of the IEEE.

Since it is a one-hundred mile drive to Boulder, from my home, I was a little bit disappointed, but I was able to jot down a few notes from these documents that you might find interesting.

Readers that would like to read these articles should contact their nearest University Library that offers an Electrical Engineering curriculum or contact: *IEEE Transactions on Broadcasting*, Philip A. Rubin - Editor, Rubin-Bednarek & Associates, Suite 610, 1350 Connecticut Avenue NW, Washington, DC 20036, for further information.

Lets look at my notes from the first 1990' era paper that compared the traditional ground radial approach to the elevated radial approach using computer modeling.

THE FIRST PAPER

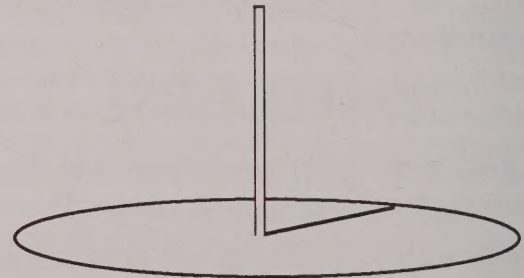
This paper introduces the basic concept of elevating four 1/4 wavelength radials above ground and compares this approach to the more traditional approach of burying a lot (120) of radials underground.

Elevated vs. Ground Mounted - The method used to model the elevated radial concept was to first model the "Classic Ground-Mounted Series Fed Tower" that will be used as a reference. The field strength of this model is measured and then compared to the field strength of various "Elevated Radial Configurations".

Defining the Classic Set Up - These commercial broadcast types apparently model their antennas at 1.0 Mhz., which is right in the middle of the medium wave AM broadcast band. The tower is 1/4 wavelength high and the use of 120 buried 1/4 wavelength copper radials is assumed. The radials are buried at a depth of six inches. Appropriate parameters for soil conductivity (0.004 Siemens per meter) and dielectric constant (15) are made to satisfy the model.

Classic Radial System

MODEL FREQUENCY - 1.0 MHZ. (1/4 WAVE TOWER)
RADIAL QUANTITY - 120 (EVERY 3°)
ORIENTATION - GROUND MOUNTED 6" DEEP
RADIAL LENGTH - 1/4 WAVELENGTH
FIELD STRENGTH - 267.91 MV/METER RMS



NOTE: ONE RADIAL IS SHOWN

This "Classic" test set up was first used in the Ground Systems as a Factor in Antenna Efficiency, by Brown-Lewis-Epstein, that appeared in *The Proceedings of the Institute of Radio Engineers*, Volume 25, Number 6, June 1937.

The Payoff for the Classic Model - This "Classic" vertical is fed with a kilowatt and the power is measured a kilometer away from the tower at a height above ground of 50 inches.

The "Classic" model yields a field strength of 267.91 millivolts per meter rms.

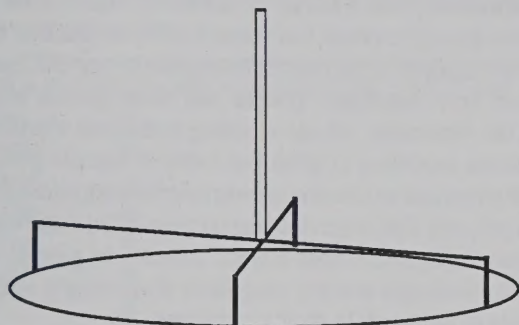
Elevated Radial Comparisons - Two basic elevated radial approaches were analyzed using four elevated radials. The first model elevates the four 1/4 wavelength radials to a 5 meter level. The second approach raises the four 1/4 wavelength radials to a height of 10 meters.

Various subtle modifications to each elevated model are tried that vary the feed point from ground level to the level of the radial, radial lengths are extended an additional length equal to that of the radial elevation and the supports for the elevated radials are changed from metallic to non-metallic.

The Winner Is - There are six basic elevated combinations that are modeled. The worst case scenario yielded 256.8 millivolts per meter rms. The best case scenario yielded 266.7 millivolts per meter rms. Conclusion: Four elevated 1/4 wavelength radials merits some real world investigation as a substitute for 120 ground mounted radials.

Elevated Radial System

MODEL FREQUENCY - 1.0 MHZ. (1/4 WAVE TOWER)
RADIAL QUANTITY - 4 (EVERY 90°)
ORIENTATION - 5 TO 10 METERS ABOVE GROUND
RADIAL LENGTH - 1/4 WAVELENGTH + HEIGHT
FIELD STRENGTH - 266.70 MV/METER RMS



NOTE: ELEVATED FEED SHOWN

THE SECOND PAPER

Elevated radials are added to a "mature" underground radial system in this paper to improve antenna efficiency.

Some Valuable Reference Data - The initialization of the study yields some very valuable data that might give those who don't believe in ground systems something to ponder.

1. Ground Rod Only System - This is a vertical with no radials at all just a two meter long ground rod. This yielded a wimpy 125.57 millivolts per meter rms.

2. Four Buried Radial System - This compromise yielded a field strength of 225.56 millivolts per meter rms.

3. In all cases studied the field strength measured at the end of the radials was the same as at the 45° angle bisecting any of the two radials.

Study Details - This study compares various four 1/4 wavelength elevated radial systems that are installed over an existing damaged ground mounted radial system. Metallic vs. non-metallic supports are studied. The 10 meter radial height is compared to the 5 meter radial height. Various feed point point orientations are studied.

The New Winner Is - The elevated radial system with metallic supports, 10 meters high, with a high feed point wins out with a nice 308.42 millivolts per meter rms. This system sits right on top of an existing "very deteriorated" ground mounted radial system. Conclusion: The results of this study would indicate that the addition of an elevated radial system above an existing ground mounted radial system would also be worth pursuing.

Follow Up - The implementation of an elevated radial system on the 160 meter band will be pursued in another article. Thanks again to Jane L. Watterson, of the MASC, U.S. Department of Commerce Library, for assisting me in locating these articles.

The Ground Plane One - GP-1

Radials Are the Key - Back in the late 70's Low Band DX fever was running quite high where I lived in the Kansas City area. As a beginner, I sought the advice of the local sages from the Kansas City DX Club.

"Radials are the key - as many ground radials as you can afford", was the response.

A wire purchase was made that would impress a telephone company executive and the radial process was started at the base of my tower in a Spring Hill, Kansas milo field.

My method utilized a two foot diameter copper ring made of heavy gage wire for the center hub. I would unspool the insulated radial wire to the proper length, drive the far end into the ground with a large nail, remove the insulation from the end of the radial and then solder it to the copper ring using a torch.

The Motivation - On one particularly cool day while using my razor sharp utility knife to dress the wire leads I noticed that I had slashed my jeans with a 3 -4" slice of the knife. Initial inspection indicated that I must have also spilled a cup of coffee because the jeans were soaked. Further inspection indicated that the slash had penetrated my leg by about a half an inch and that I was bleeding like a stuck pig!

This was a rural area and I was starting to "see the stars". I limped about one hundred yards over to my neighbors trying to stop the bleeding and was lucky to get a ride to the Olathe, Kansas clinic, that was about fifteen miles away. You don't want to drive alone under these conditions.

I was really a mess. Due to the cold, I didn't sense the cut, and I had about a square foot of blood distributed on my jeans. I limped into the Olathe, Kansas Clinic Emergency Room and advised the nurse that I would be needing a few stitches for this rather deep cut.

The nurse advised me that I would have to wait for an hour or so because they had just received seven victims of a head-on collision who were all in critical condition. She advised me that if I took off my jeans, she would keep me supplied with clean towels until the wound could be sewn up.

While sitting in the waiting room in my underwear, holding a towel on my leg, talking to the friends and relatives of the crash victims, I decided that there has to be a more elegant way to deal with ground radials!

The Design - My friend, Larry Mills, WBØUXI, hydro-plane racing champion, telescope builder, skeet shooting champion, amplifier designer and electrical consultant, was contacted and the design process was started.

Larry's design incorporated twenty-four tie points, a ten inch diameter that would nest neatly inside Rohn 25G tower, and the ability to mount the hub securely on a mast of up to two inches.

The GP-1 is cast using a material called Alumaloy, that is 10 percent magnesium and 90 percent aluminum.

This design provides the owner with a tremendous amount of flexibility and makes the radial installation process easy to manage.

If you are serious about a radial system for your low band antenna system, you would be wise to consider the purchase of a GP-1 at only \$35.95 postpaid in the U.S.

It's sanitary look is perfect for amateurs with small backyards. The GP-1 also is perfect for those who take down their antenna systems for maintenance during the summer. The GP-1 is available from: Lance Johnson Engineering, P.O. Box 1047, Elizabeth, CO 80107, (303) 646-4630.

Real World Elevated Radials

Share The Workout - by KØCS

The two articles from the *IEEE Transactions on Broadcasting* regarding elevated radials deserve our attention. The authors have provided us with a possible backyard antenna strategy that would be efficient, cost effective and flexible on either 40, 80, or 160 meters.

Ground Radials vs. Elevated - For the 160 meter band example, the use of four elevated radials instead of one hundred and twenty ground mounted radials is very cost effective. Let's use 131.5 feet as a 1/4 wave radial length. At a mere \$0.05/foot (for insulated copper wire) times 131.5 feet, you have \$6.58 in one 1/4 wave radial. If you extend this to 120 radials you have invested \$789.00 for your 160 meter ground system and you still have to complete the very labor intensive installation.

Support Selection - The authors modeled their 1.0 mhz. example at a height of 5 and 10 meters. For this 160 meter example we will use nine supports (two for each radial) made up of steel fence posts (\$2.00 each) and 10 foot long sections of PVC pipe (\$7.99).

The PVC pipe, if carefully chosen with the fence pipe, will fit snugly over the pipe permitting a telescoping type of extension that will yield up to 14 feet of elevation for each support.

Four PVC "T" connections (\$1.50) are used on the middle supports and four bungee cords (\$2.00) are used at each end to facilitate the take down during the initial tune up process. The bungee cords can be removed later, but make the iterative process of tuning a lot more forgiving during the early stages.

The entire support system can be up in less than one hour. If you don't drive the steel fence post too far into the ground the support system can be taken down in under an hour.

When you buy PVC pipe you will notice that there are three colors available. A grey, a tan and a white. In Colorado, the white PVC pipe is almost invisible to the eye during the winter. This summer we have had very little rainfall and the tan PVC pipe would provide more stealth.

Installation of the Radials - The recommended approach for the 1/4 wave radial length has been to use the formula length for a 1/4 wave radial and then add the height above ground to that length.

John Brosnahan, WØUN, provides an ingenious method for tuning elevated radials that merits our attention. This approach was discussed at the 1993 Dayton Hamvention Antenna™ Forum. John recommends, on elevated radials, that you temporarily feed each pair as you would a typical dipole at the desired frequency, and then trim the length for minimum SWR.

This approach works well and can be accomplished with some short alligator clip leads and a bit of power from your transceiver. Just be sure to watch for RF burns. You are now beginning to see why the bungee cords come in handy.

The Lance Johnson Engineering, Ground Plane One, GP-1 (\$35.95) is used at the elevated center hub to connect the feedline braid and four elevated radials. The GP-1 bolts snugly to the PVC pipe.

After the radials have been installed you may want to back guy each of the four supports to eliminate any sag in the radials. If

you can tolerate the sight of slightly bowed PVC pipe you can also use this method for removing the sag in each radial. The choice is yours.

The Vertical Radiator - For this exercise a 131.5 foot long piece of #12 wire was used as a radiator. The end of the wire was attached to the top of 115 foot tower. It is important to note that any vertical radiator could have been used. Your Butternut HF-2V with the 160 meter coil, a shunt fed tower, even a full size 1/4 wave vertical. Any vertical radiator will benefit from an efficient ground system.

Evaluation of the System - Once the elevated radial system is installed it is appropriate that some form of evaluation be done that addresses some of the conclusions made by our IEEE authors. These are very intelligent people and their efforts merit our respect, but remember, we are working in the real world now.

Antenna modeling is great but I doubt that the people that wrote the paper had an elevated power line running parallel to their western property line, a service line coming in from the east, nine Ponderosa Pines, three other towers, a three car garage, storage shed, five Beverages and my neighbors disgustingly ugly metal horse barn to the south in their parameters.

Lets see if we can measure and replicate some of the more interesting conclusions derived by the authors:

1. Will four elevated radials exhibit an omnidirectional radiation pattern or will field strength be stronger off the ends of the radials?

2. Will four elevated radials perform better than only two elevated radials?

3. Will the addition of twenty-four short (61 foot) radials at ground level improve field strength?

4. Will the addition of four 1/4 wavelength radials at ground level directly below the elevated radials improve field strength?

The temperatures in Denver have been in the 90's F during the day, but cool to the 70's in the evening. This examination turned out to be a great aerobic workout.

The Test Beacon - A test beacon was programmed on my Kansas City Keyer™ that would send a series of V's, identify my call, pause for 15 seconds and then repeat. The fifteen second interval worked out well for the readings taken close to the radials but for the measurements taken at the 500 foot distance from the antenna a longer interval might be advised.

Try to keep the power as low as possible and perform the evaluation during off hours when the 160 meter band is useless. This is not hard to do in Colorado during the month of July.

Be sure to record the exact power settings used with your transceiver if you do not perform the various test evaluations in one session.

The field strength meter used was an inexpensive Calrad model that has a sensitivity control. I was able to obtain readings near the radials with the sensitivity at 50 percent without pegging the meter. At the 500 foot, far field distance I used the full sensitivity of the meter to obtain the readings.

Before you formally begin collecting field strength readings just make sure that you have no areas that peg your field strength

meter. If you do, either lower the output at the transceiver or reduce the sensitivity of the meter so that an actual parameter can be recorded.

Field Strength Readings - The most important aspect of obtaining these readings is your ability to be consistent with your method. In my case I selected fence posts that provided a support for the field strength meter that would guarantee that the exact location was selected for each of the tests. If supports are not available simply mark each of your spots in the field with a small wooden peg and mount the field strength meter on a yardstick or similar support.

Remember, we are looking for relative changes in field strength and anything you can do to standardize your measurement technique will provide more accurate analysis.

Omnidirectional Pattern - The following data was recorded for the sake of determining if the four elevated radials exhibit an omnidirectional pattern:

NEAR FIELD READINGS @ 135 Feet

90°	2
135°	7
180°	4
225°	6
270°	5
315°	5
0°	5
45°	6

FAR FIELD READINGS @ 500 Feet

90°	3
135°	3
180°	7
225°	5
270°	3
315°	1
0°	6
45°	3

The elevated radials are positioned at the 45, 135, 225 and 315 degree orientations. Notice how on some of the field strength readings a consistent level is seen and then some apparent degradation and enhancement is observed, caused by offending structures. However, it would appear that the four elevated radials are tending towards an omnidirectional pattern.

I don't want to bore you with a lot of detail about terrain or surrounding structures, but the low reading in the 315 degree direction can be attributed to the tower guys, four pine trees and a power pole within one wavelength of the 160 meter vertical.

It is a wonder that I am able to work Japan on 160 meters with any consistency at all.

A vertical really does require a large amount of real estate to be effective

Four Elevated vs. Two Elevated Radials - Lets remove two of the elevated radials from the system. The 135 and 315 degree orientations are removed and the 45 and 225 degree orientations remain. Please note that a different power level was used here and that these individual field strength readings are not relevant to the readings in the omnidirectional observations.

NEAR FIELD READINGS (2 Radials/4 Radials)

90°	2/2
135°	3/5
180°	4/4
225°	12/7
270°	5/5
315°	3/5
0°	3/3
45°	15/7

FAR FIELD READINGS (2 Radials/4 Radials)

90°	3/3
135°	2/2
180°	8/8
225°	1/1
270°	9/9
315°	2/2
0°	7/7
45°	4/4

This is very interesting! Notice the change in the near field readings as you go from two to four elevated radials. Some of the orientations are being degraded (135 and 315 degrees), but the 225 and 45 degree orientations are being enhanced significantly which is broadside to the two elevated radials. Before we get real excited with this result lets look at the far field.

Notice the far field results. The far field measurements for two elevated radials are the same as for four elevated radials. I had to be sure about this result so I took another set of readings on this evaluation and came up with the same result. **In the far field I could see no difference between two vs. four elevated radials!**

This result has some very interesting implications with respect to cost and should also be of interest to those enthusiasts who run multiple element vertical arrays.

Note: When you stumble across something like this it is a good idea to consult with someone who has some background of the professional variety, as I sensed possible cockpit error. Maybe my neighbors ugly metal horse barn was causing an aberration. I contacted John, WØUN, who advised me that the original work done on ground plane antenna systems years ago utilized only two radials and that it was for cosmetic/commercial type purposes that the third and sometimes fourth radial was added so that the antenna "looked" omnidirectional. He advised me that my results were not surprising.

Elevated Radials Enhanced by Short Ground Radials -

This is the case where a group of 24 short radials (61 feet long) are added at the base of the center hub at ground level and compared to the four elevated radials only.

This is a worthy examination because the second paper from the *IEEE Transactions on Broadcasting* indicated that the combination of a deteriorated ground radial system and an elevated radial system had more field strength than either of the two systems considered alone.

It would certainly be easy enough to add a few radials to the ground and see if the combination enhances the performance of the elevated system. Lets begin by adding a group of short radials from an 80 meter vertical directly below our existing elevated radial system.

NEAR FIELD READINGS

(4 Elevated Only/ 4 Elevated + 24 on Ground) Ground Radials
Not Connected (Floating) to Elevated Radials.

90°	4/4
135°	13/9
180°	7/6
225°	15/12
270°	13/12
315°	9/11
0°	9/9
45°	9/6

FAR FIELD READINGS

(4 Elevated Only/ 4 Elevated + 24 On Ground)

90°	5/4
135°	3/2
180°	7/9
225°	8/3
270°	3/3
315°	3/2
0°	12/12
45°	7/6

At this point you can guess that I am probably disappointed. I am not seeing any enhancement of note. Almost all orientations in both the near and far fields are degrading the field strengths. I realize that my ground level system is floating and is not physically connected to my elevated radial system so I decide to take a set of readings with the two levels electrically connected with a piece of #10 copper wire.

NEAR FIELD READINGS

(4 Elevated Only/ 4 Elevated + 24 On Ground) Ground
Radials Connected to Elevated Radials.

90°	4/4
135°	13/12
180°	7/6
225°	15/12
270°	13/10
315°	9/16
0°	9/8
45°	9/7

FAR FIELD READINGS

(4 Elevated Only/ 4 Elevated + 24 On Ground) Ground
Radials Connected to Elevated Radials.

90°	5/4
135°	3/2
180°	7/8
225°	8/3
270°	3/2
315°	3/2
0°	12/11
45°	7/5

Now we are really going nowhere! In both cases I am seeing no improvement with the addition of the shortened group of radials at the base of the tower. The far field readings are starting to go down in every direction. Lets try one more evaluation.

Elevated Radials Enhanced by Long Ground Radials -

The next evaluation will look at four elevated radials with the 24 short radials beneath at ground level, plus the addition of four 133 foot long ground radials directly beneath the elevated radials.

NEAR FIELD READINGS

(4 Elevated Only / 4 Elevated + 24 On Ground + 4
Additional 1/4 Wavelength Radials Below)

90°	4/3
135°	13/5
180°	7/5
225°	15/11
270°	13/10
315°	9/17
0°	9/7
45°	9/8

FAR FIELD READINGS

(4 Elevated Only/ 4 Elevated + 24 On Ground + 4 Additional 1/4
Wavelength Radials Below)

90°	5/4
135°	3/2
180°	7/8
225°	8/3
270°	3/3
315°	3/2
0°	12/8
45°	7/4

At this point I am not happy. I have added 24 short (61 foot) radials at ground level and then four more 133 foot radials at ground level and my field strengths are dropping. My conclusion at this point is that at my QTH the additional radials on the ground are not going to give me any additional enhancement and that the use of only four elevated radials will be the best approach.

Conclusion - Readers of this article should be advised that this evaluation was made over very poor soil conductivity at an altitude of 6,600 feet above sea level. Your results will vary with mine I am sure if you are fortunate enough to have good ground conductivity.

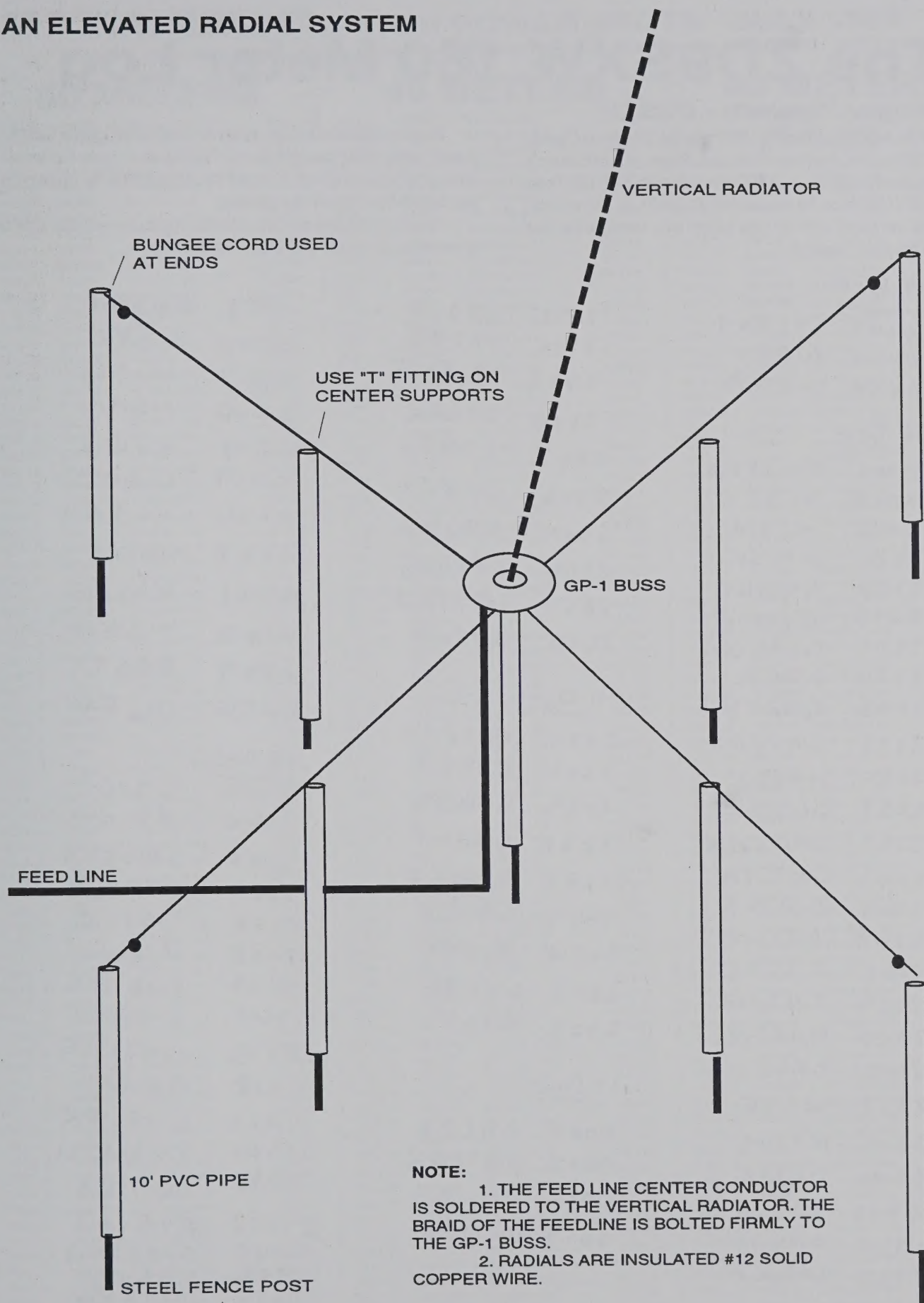
It is obvious that my five acre lot is not enough real estate to provide a "proper" environment for a truly sanitary 160 meter vertical installation that would adhere to the results obtained by computer modeling.

This study has definately been worthwhile for me because it has given me a method for taking my somewhat compromised situation to the better level, plus it's good exercise!

My next approach will be to compare the "bent" radiator to a shunt fed radiator in a purely vertical orientation.

The addition of as few as two elevated radials can indeed improve your performance on the lower frequency bands and should be considered as a cost effective enhancement to vertical antenna performance.

AN ELEVATED RADIAL SYSTEM



The ZD9SXW 160 Meter Log

With Roger Western - G3SXW

One of the best operations of 1993 was the Tristan da Cunha, ZD9SXW DXpedition by Roger Western. Roger, one of Europe's best CW operators made over 23,000 contacts with 2759 QSO's on 40 meters, 687 QSO's on 80 meters and 81 QSO's on 160 meters.

Roger's 160 meter activity was halted by a strong wind that blew down his GAP vertical.

Roger advises that at any given time on the 160 meter band he would rarely hear more than one signal at a time. He would constantly have to check the band for propagation by calling CQ and hopefully uncover the opening.

Those of you that made it into this log have certainly joined a very elite group of "Top Band" enthusiasts.

4 Oct

0203 PY1BVY
0444 W4ZV
0450 W2JB

10 Oct

2205 G43YDX
2208 VE1ZZ
2212 K1ZM
2214 IV3PRK
2216 G4BUC
2218 G3KMA
2221 G130GR
2226 K2EK
2228 G3RTY
2233 SM5EDX
2234 HA8DZ
2237 G4BUE
2239 SM4CAN
2242 G43ITN
2248 G3LNS
2249 DJ8WL
2252 G3ZFC
2256 G4DBN
2300 HA8FM
2302 DK6ED
2307 W1ZE
2311 K2DM
2314 DL7PR
2318 OZ1LO
2320 ON4UN
2322 W3BGN

2332 UB3JX
2334 OZ7YY
2337 ON5NT
2340 DJ6RX
2343 KD9SV
2346 DF6RX
2349 K9UWA
2354 OZ1ING
2357 OM3TWJ
2359 G3PQA

11 Oct

2222 IV3PRK
2223 ZD8VJ
2229 G3WVG
2231 G4BWP
2233 G3MXJ
2249 G3SZA
2254 DL1YD
2258 G4LJF
2309 DJ2Ti

12 Oct

0005 OH1XX
0012 OM3CQR
0013 OH1MH
0019 DL4ZB

0159 G43POI
0200 W49Z
0202 N4SU
0210 N6AR
0214 KV4G
0219 W1OC
0226 VO1NA
0237 N6DX
0241 KALPE
0243 N4XA
0249 AA6TT
0256 W1FV

13 Oct

2238 G3RBP
2240 PY2BW
2245 SM6CVX
2249 PY2NG
2252 G4IVZ
2258 PY6WC
2303 SM6CTG
2305 G3XTT
2313 OM3CSQ
2318 G4AKY
2322 OM3CQR
2326 SM4ASU
2332 OZ7JZ
2342 E15UJ
2345 OM3CSA
2352 DK6ED
2355 G42BVM

LOW BAND MONITOR POWER SPOTS - JULY 1994

TNX: N8BJQ - N2KK - NI6T - K6SSS - K9FD - KC7V - AA6TT - W8AH - WAØGFS - WØZV

40 METERS

7002.0	1A0KM	06-Jul-94	0257Z
7000.8	TT/F5LGF	06-Jul-94	0344Z
7002.1	1A0KM	06-Jul-94	0345Z
7001.1	TT/F5LGF	06-Jul-94	0420Z
7205.0	VR6DB	06-Jul-94	0604Z
7001.9	VK9NS	06-Jul-94	1059Z
7004.7	1A0KM	07-Jul-94	0236Z
7007.5	VK3BYE	07-Jul-94	1003Z
7003.9	A35MW	07-Jul-94	1103Z
7007.7	UAØFAI	07-Jul-94	1317Z
7004.5	V31PH	08-Jul-94	0320Z
7019.0	OA4EI	08-Jul-94	0345Z
7001.7	LU4FC	09-Jul-94	0221Z
7007.8	II8GS	09-Jul-94	0252Z
7011.8	SO6BVK	09-Jul-94	0254Z
7004.6	SV1AOZ	09-Jul-94	0321Z
7205.0	T30JH	09-Jul-94	0636Z
7205.0	VR6DB	09-Jul-94	0639Z
7013.8	V73C	09-Jul-94	1114Z
7010.4	YS1XS	09-Jul-94	1126Z
7007.0	TNOCW	10-Jul-94	0001Z
7024.9	HH2PK	10-Jul-94	0051Z
7011.1	OM9HQ	10-Jul-94	0102Z
7005.3	RU6L	10-Jul-94	0102Z
7017.6	LY6M	10-Jul-94	0104Z
7018.3	SL0CB	10-Jul-94	0104Z
7005.1	T9A	10-Jul-94	0104Z
7025.0	HH2PK	10-Jul-94	0106Z
7010.0	EM5HQ	10-Jul-94	0107Z
7026.0	UX2HO	10-Jul-94	0107Z
7013.1	HG94HQ	10-Jul-94	0109Z
7014.7	S51QZ	10-Jul-94	0110Z
7014.2	US9Q	10-Jul-94	0111Z
7036.5	C49C	10-Jul-94	0115Z
7057.7	CR3R	10-Jul-94	0123Z
7045.6	LZ7A	10-Jul-94	0128Z
7043.3	LY2ZZ	10-Jul-94	0131Z
7026.6	YPOA	10-Jul-94	0134Z
7040.8	OM9HQ	10-Jul-94	0137Z
7010.2	EM5HQ	10-Jul-94	0142Z
7050.0	CT8T	10-Jul-94	0145Z
7005.0	OH2C	10-Jul-94	0146Z
7004.5	T9A	10-Jul-94	0147Z
7078.5	OZ1BTE	10-Jul-94	0154Z
7047.2	EM5HQ	10-Jul-94	0159Z
7024.2	UT4PZ	10-Jul-94	0202Z
7010.1	OX/WJ2O	10-Jul-94	0205Z
7016.0	OA4CWR	10-Jul-94	0212Z
7053.5	YPOA	10-Jul-94	0212Z
7057.2	GMØECO	10-Jul-94	0213Z
7022.8	LXØRL	10-Jul-94	0218Z
7096.5	ØT4H	10-Jul-94	0248Z
7007.0	LY2BM	10-Jul-94	0249Z
7012.5	ZA1J	10-Jul-94	0253Z
7028.1	X5EBL	10-Jul-94	0321Z
7015.4	II8GS	10-Jul-94	0335Z
7084.3	CR3R	10-Jul-94	0429Z
7046.5	ZP5JCY	10-Jul-94	0455Z
7000.7	TNOCW	10-Jul-94	2206Z
7001.8	5T5JC	10-Jul-94	2311Z
7004.5	TT/F5LGF	10-Jul-94	2331Z
7004.5	TT/F5LGF	11-Jul-94	0016Z
7003.9	8P9GY	12-Jul-94	0208Z
7004.0	TNOCW	12-Jul-94	0224Z
7003.2	OX/WJ2O	12-Jul-94	0441Z
7018.5	UX7FN	13-Jul-94	0018Z
7009.0	TNOCW	13-Jul-94	0126Z
7005.6	T91EVC	13-Jul-94	0135Z
7006.6	TNOCW	13-Jul-94	0217Z
7004.5	TNOCW	14-Jul-94	0522Z
7001.4	ZL8BX	14-Jul-94	1008Z
7000.6	T91EBG	14-Jul-94	2248Z
7004.9	C53HG	15-Jul-94	0059Z
7001.0	9K2ZZ	15-Jul-94	0104Z
7003.4	9Y4VU	15-Jul-94	0112Z
7007.1	ZA1J	15-Jul-94	0145Z
7003.0	CX5BW	15-Jul-94	0347Z
7005.4	TNOCW	15-Jul-94	0538Z

40 METERS

7011.0	HC5AI	15-Jul-94	1110Z
7122.7	CO2FC	15-Jul-94	1304Z
7001.2	9K2ZZ	15-Jul-94	2329Z
7020.5	CO2JD	15-Jul-94	2355Z
7003.9	ZS6QU	16-Jul-94	0026Z
7002.6	EA8ADJ	16-Jul-94	0102Z
7009.5	CX8RI	16-Jul-94	0104Z
7003.0	3B8CF	16-Jul-94	0254Z
7010.9	CM4BM	16-Jul-94	0305Z
7008.7	CM3II	16-Jul-94	0408Z
7006.9	A35XC	16-Jul-94	0937Z
7011.8	V73C	16-Jul-94	1056Z
7001.2	ZL8BV	16-Jul-94	1106Z
7001.2	ZL8BX	16-Jul-94	1106Z
7003.2	A35XC	16-Jul-94	1122Z
7004.9	FK8FU	16-Jul-94	1331Z
7007.9	VQ9TP	16-Jul-94	1350Z
7007.1	8P6CF	16-Jul-94	2348Z
7014.2	VO9XX	16-Jul-94	2350Z
7022.6	US4LGW	16-Jul-94	2353Z
7002.1	ISØØMH	16-Jul-94	2357Z
7006.5	DL1IAO	17-Jul-94	0015Z
7007.4	LU3XQ	17-Jul-94	0016Z
7025.9	6W6JX	17-Jul-94	0046Z
7004.8	S51DQ	17-Jul-94	0102Z
7005.5	LU1WFA	17-Jul-94	0400Z
7001.9	LU5FIL	17-Jul-94	0412Z
7003.5	G4BUE	17-Jul-94	0423Z
7016.0	6W6JX	17-Jul-94	0639Z
7006.0	FR5DN	17-Jul-94	0314Z
7005.0	A35XC	17-Jul-94	0952Z
7012.0	YS1VV	17-Jul-94	1043Z
7005.6	A35XC	17-Jul-94	1103Z
7006.4	FS5PL	18-Jul-94	0136Z
7015.2	IK1TVQ	18-Jul-94	0152Z
7010.8	FG5FR	18-Jul-94	0249Z
7003.0	SV2AVP	18-Jul-94	0427Z
7003.5	EA1FBW	18-Jul-94	0611Z
7015.6	YØØRCV	18-Jul-94	0622Z
7015.1	YØØRCV	18-Jul-94	1134Z
7003.4	9Y4VU	19-Jul-94	0119Z
7019.9	UR7GR	19-Jul-94	0152Z
7012.4	ZL8BX	19-Jul-94	0920Z
7008.0	A35XC	19-Jul-94	0924Z
7012.2	ZL8BX	19-Jul-94	1028Z
7014.8	A35XC	19-Jul-94	1059Z
7007.0	BZ5DX	19-Jul-94	1312Z
7012.0	VR2IH	19-Jul-94	1329Z
7009.8	9M2JP	19-Jul-94	1412Z
7002.5	HP1XBH	20-Jul-94	0053Z
7004.8	YØØRCV	20-Jul-94	0059Z
7008.3	FG5FR	20-Jul-94	0205Z
7003.7	VP2EP	20-Jul-94	0236Z
7082.0	YØØRCV	20-Jul-94	0308Z
7003.3	EA6NB	20-Jul-94	0406Z
7003.6	YØØRCV	20-Jul-94	0947Z
7003.5	YØØRCV	20-Jul-94	1009Z
7004.5	VP2EP	20-Jul-94	1012Z
7003.5	YØØRCV	20-Jul-94	1026Z
7006.8	BZ4REB	20-Jul-94	1240Z
7003.4	5W1GC	20-Jul-94	1250Z
7070.0	UUØSPY	21-Jul-94	0040Z
7005.4	TT/F5LGF	21-Jul-94	0203Z
7004.0	3B8CF	21-Jul-94	0308Z
7009.7	FY5GJ	21-Jul-94	0308Z
7018.5	UA2FP	21-Jul-94	0334Z
7006.9	ØK1AUN	21-Jul-94	0415Z
7004.5	LU1WFA	21-Jul-94	0432Z
7009.0	Z31GB	21-Jul-94	0434Z
7001.4	VP2EP	21-Jul-94	0436Z
7007.5	S51QZ	21-Jul-94	0441Z
7002.5	YØØRCV	21-Jul-94	0450Z
7002.5	YØØRCV	21-Jul-94	0601Z
7010.2	YØØRCV	21-Jul-94	0848Z
7005.8	ZA1J	22-Jul-94	0132Z
7007.5	LZ2KRU	22-Jul-94	0133Z
7005.9	HB9ZE	22-Jul-94	0146Z
7085.0	YØØRCV	22-Jul-94	0221Z

40 METERS

7013.0	UR7GR	22-Jul-94	0224Z
7025.2	3DAØCA	22-Jul-94	0502Z
7012.3	9J2BO	22-Jul-94	0507Z
7005.0	YØØRCV	22-Jul-94	0529Z
7001.0	A35XC	22-Jul-94	0612Z
7015.0	YØØRCV	22-Jul-94	0817Z
7004.9	YØØRCV	22-Jul-94	2221Z
7004.3	GI3ØQR	23-Jul-94	0001Z
7001.3	ØM5XX	23-Jul-94	0100Z
7005.5	YØØRCV	23-Jul-94	0120Z
7005.1	CM5DK	23-Jul-94	0142Z
7004.9	YØØRCV	23-Jul-94	0143Z
7007.1	ØM3CAE	23-Jul-94	0147Z
7013.5	US9QA	23-Jul-94	0156Z
7010.3	UY5UG	23-Jul-94	0201Z
7014.5	UY5BA	23-Jul-94	0247Z
7008.0	LU8DZJ	23-Jul-94	0253Z
7006.5	UXØZD	23-Jul-94	0254Z
7007.0	Z31GW	23-Jul-94	0324Z
7005.9	YØØRCV	23-Jul-94	0350Z
7005.3	SU2MT	23-Jul-94	0424Z
7005.2	YØØRCV	23-Jul-94	0455Z
7001.0	5W1GC	23-Jul-94	0804Z
7010.0	YØØRCV	23-Jul-94	0913Z
7005.2	FG5FR	23-Jul-94	1052Z
7007.7	VK6HQ	23-Jul-94	1219Z
7001.4	7P8SR	23-Jul-94	2249Z
7085.0	YØØRCV	24-Jul-94	0220Z
7011.0	US9QA	24-Jul-94	0222Z
7004.8	Z31GB	24-Jul-94	0231Z
7015.2	V31ML	24-Jul-94	0235Z
7010.8	YØ9YE	24-Jul-94	0239Z
7012.0	ZA1J	24-Jul-94	0245Z
7004.6	Z31GB	24-Jul-94	0250Z
7013.2	S51DQ	24-Jul-94	0342Z
7001.7	ØN6KD	24-Jul-94	0400Z
7004.3	Z31GB	24-Jul-94	0401Z
7005.0	4U1ITU	24-Jul-94	0402Z
7057.5	ZP5CGL	24-Jul-94	0414Z
7085.0	YØØRCV	24-Jul-94	0422Z
7006.5	4U1ITU	24-Jul-94	0426Z
7004.0	EA6NB	24-Jul-94	0428Z
7083.0	YØØRCV	24-Jul-94	0435Z
7012.4	ZWØMI	24-Jul-94	0514Z
7002.8	Z21HS	24-Jul-94	0521Z
7012.4	ZWØMI	24-Jul-94	0534Z
7004.3	4U1ITU	24-Jul-94	0556Z
7003.0	PZ1DV	24-Jul-94	0629Z
7013.0	5W1GC	24-Jul-94	0721Z
7003.9	YØØRCV	24-Jul-94	0736Z
7006.8	YØØRCV	24-Jul-94	0924Z
7006.0	YØØRCV	24-Jul-94	1025Z
7003.3	A35XC	24-Jul-94	1033Z
7013.0	BZ4RCZ	24-Jul-94	1100Z
7004.6	YØØRCV	24-Jul-94	1119Z
7005.0	Z21HS	24-Jul-94	1421Z
7004.0	YØØRCV	24-Jul-94	2359Z
7005.8	ZA1J	25-Jul-94	0023Z
7001.5	5B4WN	25-Jul-94	0024Z
7013.3	UR5ZFU	25-Jul-94	0235Z
7018.3	EA6EE	25-Jul-94	0237Z
7005.1	FG5ED	25-Jul-94	0248Z
7010.3	FG5FR	25-Jul-94	0250Z
7012.4	S51DQ	25-Jul-94	0252Z
7003.3	3B8CF	25-Jul-94	0252Z
7007.7	SP2QCH	25-Jul-94	0301Z
7008.0	T92A	25-Jul-94	0342Z
7004.9	YØØRCV	25-Jul-94	0425Z
7008.5	PY8AZA	25-Jul-94	0457Z
7005.0	YØØRCV	25-Jul-94	0458Z
7007.9	IK5NFI	25-Jul-94	0458Z
7003.4	G4BUE	25-Jul-94	0500Z
7003.4	ZL4FC	25-Jul-94	0501Z
7004.9	YØØRCV	25-Jul-94	0600Z
7005.7	YØØRCV	25-Jul-94	1108Z
7003.3	VK2GS	25-Jul-94	1115Z
7005.4	T92A	26-Jul-94	0022Z
7003.8	SP2QCH	26-Jul-94	0147Z

LOW BAND MONITOR POWER SPOTS - JULY 1994

TNX: N8BJQ - N2KK - N16T - K6SSS - K9FD - KC7V - AA6TT - W8AH - WAØGFS - WØZV

160 METERS

1832.0	ZL2JR	3-Jul-94	0956Z
1832.0	VP5NC	10-Jul-94	0324Z
1835.0	HH2PK	10-Jul-94	0412Z
1834.6	PT7CB	10-Jul-94	0415Z
1844.0	PY0FF	10-Jul-94	0431Z
1835.0	DA0HQ	10-Jul-94	0124Z
1827.0	TN0CW	14-Jul-94	0342Z
1827.0	TN0CW	14-Jul-94	0440Z
1827.0	TN0CW	14-Jul-94	0500Z
1840.0	LU8DNY	15-Jul-94	0104Z
1840.2	9A2TW	15-Jul-94	0109Z
1840.0	OZ1BTE	15-Jul-94	0113Z
1832.8	PY5CC	15-Jul-94	0131Z
1833.0	GI0NWX	15-Jul-94	0143Z
1827.2	OK1DTM	15-Jul-94	0153Z
1827.0	TN0CW	15-Jul-94	0338Z
1827.2	TN0CW	15-Jul-94	0432Z
1827.0	TN0CW	15-Jul-94	0450Z
1832.3	PY5CC	15-Jul-94	2123Z
1832.0	PY0FF	15-Jul-94	0213Z
1832.5	PY2DP	16-Jul-94	0441Z
1827.0	VK6HD	19-Jul-94	1302Z
1832.2	YW0RCV	20-Jul-94	0050Z
1832.2	YW0RCV	20-Jul-94	0145Z
1832.3	YW0RCV	20-Jul-94	0602Z
1832.0	YW0RCV	21-Jul-94	0225Z
1832.0	YW0RCV	21-Jul-94	0432Z
1832.1	YW0RCV	22-Jul-94	0327Z
1832.2	YW0RCV	23-Jul-94	0253Z
1832.1	YW0RCV	24-Jul-94	0152Z
1832.0	YW0RCV	24-Jul-94	0321Z
1832.3	YW0RCV	24-Jul-94	0400Z
1832.2	YW0RCV	25-Jul-94	0110Z
1831.0	VP2EP	25-Jul-94	0118Z
1830.7	VP2EP	25-Jul-94	0247Z
1832.0	VK2BJ	25-Jul-94	0956Z
1832.0	VK4YB	29-Jul-94	1134Z

80 METERS

3798.5	PP2BNQ	03-Jul-94	0227Z
3790.0	ZL2SN	03-Jul-94	1037Z
3799.0	VK3DZM	03-Jul-94	1055Z
3506.2	US0ZZ	04-Jul-94	0027Z
3504.0	LY1DS	04-Jul-94	0041Z
3507.0	UX2SO	04-Jul-94	0123Z
3799.6	VK2FPQ	04-Jul-94	1043Z
3799.8	VK3DZM	06-Jul-94	1044Z
3799.7	VK4SJP	07-Jul-94	1008Z
3799.5	P29VH	07-Jul-94	1301Z
3795.0	G3PCG	09-Jul-94	0101Z
3795.0	V31PH	09-Jul-94	0305Z
3790.0	OM3CGP	09-Jul-94	2344Z
3505.0	HG94HQ	10-Jul-94	0112Z
3506.5	OM9HQ	10-Jul-94	0114Z
3795.1	HG94HQ	10-Jul-94	0119Z
3504.0	DL1IAO	10-Jul-94	0125Z
3759.9	5N0MVE	10-Jul-94	0126Z
3790.2	V31WE	10-Jul-94	0130Z
3507.5	DA0HQ	10-Jul-94	0133Z
3506.5	OM9HQ	10-Jul-94	0135Z
3510.6	SP7GIQ	10-Jul-94	0142Z
3790.8	OK1MM	10-Jul-94	0149Z
3797.7	PY0FF	10-Jul-94	0150Z
3775.3	TM2T	10-Jul-94	0156Z
3790.2	PY0FF	10-Jul-94	0301Z
3506.5	OM9HQ	10-Jul-94	0308Z
3508.9	DA0HQ	10-Jul-94	0310Z
3513.2	LU1VV	10-Jul-94	0311Z
3792.2	OT4H	10-Jul-94	0314Z
3794.9	HG94HQ	10-Jul-94	0315Z
3508.6	DA0HQ	10-Jul-94	0337Z
3511.5	IK0HBN	10-Jul-94	0340Z
3797.0	HH2PK	10-Jul-94	0346Z
3525.0	TM5M	10-Jul-94	0409Z
3513.1	Z21HS	10-Jul-94	0432Z
3512.0	LU1VV	10-Jul-94	1029Z

80 METERS

3796.0	V31WE	12-Jul-94	0143Z
3501.0	TN0CW	12-Jul-94	0351Z
3505.0	TN0CW	13-Jul-94	0017Z
3503.0	SM6EHY	13-Jul-94	0151Z
3505.0	TN0CW	13-Jul-94	0248Z
3799.6	VK3DZM	13-Jul-94	1021Z
3505.3	TN0CW	14-Jul-94	0240Z
3505.0	TN0CW	14-Jul-94	0302Z
3795.1	VK3DZM	14-Jul-94	1012Z
3795.2	FK8FU	14-Jul-94	1023Z
3505.0	TN0CW	15-Jul-94	0335Z
3505.0	TN0CW	15-Jul-94	0511Z
3796.0	FT5XJ	15-Jul-94	1304Z
3790.1	HK3MCM	16-Jul-94	0111Z
3790.1	KP2AD	16-Jul-94	0156Z
3790.2	FY5GJ	16-Jul-94	0258Z
3790.1	LU6FFL	16-Jul-94	0410Z
3799.9	EA3CWK	16-Jul-94	0416Z
3794.3	PUIALH	16-Jul-94	0425Z
3789.2	PY40Y	16-Jul-94	0430Z
3795.6	3D2KM	16-Jul-94	0954Z
3799.8	P29RB	16-Jul-94	1108Z
3796.0	FK8FU	16-Jul-94	1314Z
3794.7	5N0MVE	17-Jul-94	0000Z
3508.2	VP8GAV	17-Jul-94	0053Z
3508.0	VP8GAV	17-Jul-94	0110Z
3509.9	FG5FR	17-Jul-94	0217Z
3508.9	DL1IAO	17-Jul-94	0220Z
3506.5	YW0RCV	18-Jul-94	0221Z
3506.8	SV2BOH	18-Jul-94	0318Z
3505.0	YW0RCV	18-Jul-94	0356Z
3505.0	YW0RCV	18-Jul-94	0520Z
3795.0	YW0RCV	19-Jul-94	0056Z
3505.0	YW0RCV	19-Jul-94	0117Z
3795.0	YW0RCV	19-Jul-94	0314Z
3508.8	SV2BOH	19-Jul-94	0325Z
3795.0	YW0RCV	19-Jul-94	0329Z
3504.0	TN0CW	19-Jul-94	0346Z
3505.0	TN0CW	19-Jul-94	0349Z
3504.9	YW0RCV	19-Jul-94	0422Z
3795.0	YV0RCV	19-Jul-94	0429Z
3795.0	YW0RCV	19-Jul-94	0621Z
3795.0	YW0RCV	19-Jul-94	0957Z
3796.0	WH0AAV	19-Jul-94	1256Z
3795.0	YW0RCV	20-Jul-94	0053Z
3795.0	YW0RCV	20-Jul-94	0202Z
3504.9	YW0RCV	20-Jul-94	0320Z
3505.0	YW0RCV	20-Jul-94	0417Z
3795.1	YW0RCV	20-Jul-94	0957Z
3793.0	YW0RCV	21-Jul-94	0109Z
3795.0	YW0RCV	21-Jul-94	0123Z
3505.0	YW0RCV	21-Jul-94	0138Z
3510.0	YW0RCV	21-Jul-94	0202Z
3510.0	YW0RCV	21-Jul-94	0203Z
3505.0	YV0RCV	21-Jul-94	0204Z
3505.0	YW0RCV	21-Jul-94	0313Z
3800.0	VK2GAQ	21-Jul-94	1202Z
3505.0	YW0RCV	22-Jul-94	0252Z
3795.0	YW0RCV	22-Jul-94	0318Z
3505.2	YW0RCV	22-Jul-94	0328Z
3504.0	VP2EP	22-Jul-94	0335Z
3505.0	YW0RCV	22-Jul-94	0344Z
3795.9	VK3EW	22-Jul-94	1058Z
3505.0	YW0RCV	23-Jul-94	0202Z
3505.0	YW0RCV	23-Jul-94	0215Z
3505.0	YW0RCV	23-Jul-94	0349Z
3500.9	VP2EP	23-Jul-94	0358Z
3500.9	VP2EP	23-Jul-94	0358Z
3504.0	HK7DSZ	23-Jul-94	0504Z
3799.4	ZS1RL	23-Jul-94	0507Z
3793.0	V51E	23-Jul-94	0514Z
3799.0	ZL2SN	23-Jul-94	0558Z
3505.0	YW0RCV	23-Jul-94	0929Z
3793.0	CE8EIO	23-Jul-94	1035Z
3793.1	P29VH	23-Jul-94	1045Z
3799.8	VK4CRR	23-Jul-94	1047Z
3800.0	FO5OK	23-Jul-94	1226Z
3796.0	FT5XJ	23-Jul-94	1259Z

80 METERS

3795.0	YW0RCV	24-Jul-94	0228Z
3501.0	VP2EP	24-Jul-94	0230Z
3505.0	YW0RCV	24-Jul-94	0240Z
3795.0	YW0RCV	24-Jul-94	0242Z
3505.2	YW0RCV	24-Jul-94	0351Z
3795.0	CP6DA	24-Jul-94	0443Z
3795.0	V51E	24-Jul-94	0514Z
3505.0	A35XC	24-Jul-94	0901Z
3792.0	ZF2AC	24-Jul-94	1014Z
3799.3	VK3DZM	24-Jul-94	1018Z
3799.5	FK8FU	24-Jul-94	1059Z
3800.0	ZL4BO	24-Jul-94	1213Z
3798.0	BOOM	24-Jul-94	1307Z
3500.0	JW0GB	24-Jul-94	1501Z
3795.0	YW0RCV	25-Jul-94	0048Z
3798.9	ZP5KW	25-Jul-94	0122Z
3794.9	YW0RCV	25-Jul-94	0123Z
3505.0	YW0RCV	25-Jul-94	0249Z
3505.1	YW0RCV	25-Jul-94	0306Z
3794.0	EA8PP	25-Jul-94	0418Z
3795.1	LU5HDJ	25-Jul-94	1026Z
3796.0	V63JC	25-Jul-94	1258Z
3799.0	P29VH	25-Jul-94	1340Z
3794.0	VP2EP	26-Jul-94	0225Z
3794.0	EA8PP	26-Jul-94	0228Z
3795.0	CE8EIO	26-Jul-94	0430Z
3795.0	ZP5MAL	26-Jul-94	0434Z
3792.0	EA8PP	26-Jul-94	0339Z
3792.0	9G1MR	26-Jul-94	0510Z
3798.0	V73C	29-Jul-94	1142Z
3790.0	T31BB	29-Jul-94	1154Z
7008.8	X5EBL	01-Jul-94	0221Z
7019.0	9A5D	01-Jul-94	0225Z
7013.9	7X2AB	01-Jul-94	0228Z
7003.9	LZ1FI	01-Jul-94	0255Z
7002.3	TG9AKC	01-Jul-94	0256Z
7006.2	S59AA	01-Jul-94	0332Z
7007.8	V73C	01-Jul-94	1015Z
7065.0	XX9GD	01-Jul-94	1349Z
7006.9	ZS6KO	01-Jul-94	1431Z
7009.5	ZS5LB	01-Jul-94	1445Z
7004.4	6V1A	02-Jul-94	0224Z
7009.6	FY5GJ	02-Jul-94	0251Z
7012.4	5W1GC	02-Jul-94	0605Z
7010.2	TG9AKC	02-Jul-94	1036Z
7005.4	PZ1DY	02-Jul-94	1045Z
7011.0	PY2KLP	03-Jul-94	0136Z
7008.7	PY7KE	03-Jul-94	0137Z
7004.6	PT2AZ	03-Jul-94	0140Z
7009.5	X5EXL	03-Jul-94	0304Z
7006.5	SM7CBS	03-Jul-94	0333Z
7007.1	6V1A	03-Jul-94	0509Z
7203.0	AH8E	03-Jul-94	0730Z
7013.6	YS1XS	03-Jul-94	0812Z
7203.0	VR6DB	03-Jul-94	0815Z
7003.2	RZ0LWA	03-Jul-94	0948Z
7045.0	T30JH	03-Jul-94	1036Z
7008.8	RZ0LWA	03-Jul-94	1041Z
7004.0	UA2FL	03-Jul-94	2237Z
7007.4	Z32MF	03-Jul-94	2316Z
7007.5	UX2HO	04-Jul-94	0017Z
7004.0	9A2HH	04-Jul-94	0337Z
7090.0	V73C	04-Jul-94	1002Z
7004.8	V29SW	04-Jul-94	1041Z
7008.0	CP6RP	05-Jul-94	0003Z
7003.0	OM5XX	05-Jul-94	0044Z
7004.5	X5EDL	05-Jul-94	0103Z
7014.5	4L1AA	05-Jul-94	0126Z
7000.9	1A0KM	05-Jul-94	0129Z
7043.8	1A0KM	05-Jul-94	0443Z
7205.0	VR6DB	05-Jul-94	0716Z
7205.0	T30JH	05-Jul-94	0717Z
7205.0	P40WF	05-Jul-94	0720Z
7002.1	ZL8BX	05-Jul-94	0918Z
7001.6	VK9NS	05-Jul-94	1047Z
7001.9	1A0KM	06-Jul-94	0114Z
7014.9	S83KA	06-Jul-94	0156Z
7002.0	1A0KM	06-Jul-94	0200Z